

Solar Water Heating Systems
General Information
Maryland Energy Administration (MEA)
January 2006

What are Solar Thermal Systems?

Solar thermal systems use solar collectors to absorb the sun's light and convert it into heat energy. Solar collectors heat a fluid, which is then used to provide either hot water for household use or heat for the home or business.

What are Solar Water Heating Systems?

Solar water heating systems use the sun to heat either water or a heat-transfer fluid, such as a water-glycol antifreeze mixture. This is done in collectors, which are usually mounted on the roof. An electric pump circulates the fluid through the collectors. The transfer fluid absorbs heat from the collector and then passes through a heat exchanger. The heat exchanger, which generally is in the water storage tank inside the house, transfers heat to the water. Such designs are called "indirect" (or "closed-loop") systems. The solar heated water is stored in a tank similar to a conventional electric water heater tank.

The two main types of solar collectors are flat-plate collectors and evacuated-tube collectors.

Flat-Plate Collectors

A typical flat-plate collector consists of an insulated metal box with a glass or plastic cover, called "glazing," and a dark-colored absorber plate. Sunlight passes through the glazing and strikes the absorber plate, which heats up, changing solar radiation into heat energy. The glazing allows the light to reach the absorber plate but reduces the amount of heat that can escape.

The heat energy produced in the collector is used to heat a liquid as it flows through copper pipes, in the absorber plate. In areas where freezing temperatures are common, liquid collectors must either drain the water when the temperature drops, or use an antifreeze type of heat-transfer fluid.

Evacuated-Tube Collectors

Evacuated-tube collectors consist of rows of evacuated glass tubes similar to florescent light bulbs. These tubes absorb direct and indirect solar energy and convert it to heat. Since the angle of the sunlight is perpendicular to the tube for most of the day, it performs well even when sunlight is diffuse, and is particularly useful in areas with cold, cloudy winters.

Evacuated-tube collectors can heat water to fairly high temperatures. The vacuum minimizes heat losses to the outdoors, making the collector system very efficient. Evacuated-tube collectors can achieve both higher temperatures and higher efficiencies than flat-plate collectors.

What are the costs of solar water heating systems?

Costs vary with the type and number of collectors, storage system and site conditions. The cost to install a 2.0 kW equivalent system with an 80 gallon hot water storage tank can range from under \$5,000 to over \$7,000.

What are the incentives for solar water heating in Maryland?

Grants through Maryland's Solar Energy Grant Program when funds are available. See MEA's solar grants Web site www.energy.state.md.us/programs/renewable/solargrant/ for details. Federal tax credits are available in 2006 and 2007. They are for 30% of the net system cost after other incentives. There is a cap of \$2000 for residential installations and no cap for commercial installations. Information on state and federal incentives can be found at the Database for State Incentives for Renewable Energy (DSIRE) Web site: www.dsireusa.org.

How much of the water heating load can be met by a solar water heating system?

Properly sized systems can produce up to 80% of a building's hot water loads. A back-up water heating system is still required and in retrofit situations the existing water heater is used as the backup.

What are the other benefits of solar water heating?

There are considerable environmental benefits from generating pollution-free hot water over the life of the solar water heating system.

What type of maintenance is required?

Glycol based systems require a change in the anti-freeze every three to five years at an average cost of \$100-\$200 depending on the volume of the antifreeze required, usually 4 to 8 gallons.

Drain-back systems require little maintenance.

What is the expected life of the system?

Solar thermal collectors have no moving parts and should last as long as the copper piping in a home. Protection of the collector is assured in an indirect system since public water is not in the collector. As is the case with any water heaters with storage tanks, some care is needed when systems are installed in a building using well water to ensure that the water quality will not harm the storage tank. Additional anode rods can protect a storage tank for many years.

What kind of space is needed for solar water heating?

A typical system for a family of 4 requires from approximately 40 to 80 square feet of unobstructed southern exposure. The size requirements vary depending on the type and efficiency of the collectors. Many systems will also have a separate 80 or even 120 gallon water storage tank in addition to the existing water heater.

Where can I find a qualified installer of solar water heating systems?

Local trade associations such as the Maryland-DC-Virginia Solar Energy Industries Association (MDV-SEIA: www.mdv-seia.org) are good resources for installers as well as consultants, manufacturers and distributors.

Where can I find additional information about solar water heating?

MEA's Web site www.energy.state.md.us/programs/renewable has information on Maryland's solar programs and a Consumer's Guide for Solar Water Heating. The U.S. Department of Energy's (U.S. DOE) Energy Efficiency and Renewable Energy (EERE) website (www.eere.energy.gov/solar) is a good source of information on a variety of solar energy topics.